XXI. *Effect of change of climate upon the emergence of certain species of Lepidoptera.* By Gervase F. Mathew, Fleet Paymaster, Royal Navy, F.L.S., F.Z.S., &c.

[Read October 7th, 1891.]

On the 1st January, 1891, H.M.S. 'Tyne' left Portsmouth for Hong Kong, arriving at Portsmouth again, on her return voyage, on the 2nd May. At the time of our departure I had a number of pupæ of several kinds of Lepidoptera, which were obtained, when larvæ, at Chatham and Sheerness in September, and a few pupæ, dug at Staplefield, Sussex, in August, 1890.

As the result of the effect of change of climate on these pupæ has been somewhat curious, perhaps the subjoined table of dates of emergence and temperatures will be of some interest.

Everyone will remember that last winter was an excessively severe one. The cold weather began on the 26th November, and continued throughout December. At Portsmouth on the 1st January, and at Plymouth on the 2nd January, it was somewhat milder, and there were indications of a break up of the frost; but the change was not sustained, for a couple of days after we left Plymouth the cold weather set in again with renewed vigour, and lasted well on into February. On our passage to, and through the Mediterranean, the temperature was comparatively low, and the snow upon the mountain ranges of Spain and Northern Africa was lower down the slopes than has been noticed for some years. At Malta the nights were quite cold, and we did not get into really warm weather until we had passed through the Suez Canal into the Red Sea.

Date, 1891.	Position of Ship.	Average daily temperature.	Mamestra brassicæ.	Tæniocampa stabilis.	Tæniocampa crudæ.	Hadena chenopodii.	Hadena oleracea.	Eupitheeia centaureata.	Eupitheeia subnotata.	Eupitheeia absinthiata.	Peluzga comitata.
1 Jan.	Portsmouth.	41°									
2 ,,	Plymouth.	43°									
3 ,,		52°									
4 ,,	Plymouth to	53°									
5 ,,	Gibraltar.	56°									
6 ,,		55°									
7 ,,		49°									
8 ,,	Gibraltar to	45°									
9 ,,	Malta.	45°									
10 ,,		49°									
11 ,,	Malta.	51°									
12 ,,		51°									
13 ,,		56°									
14 ,,	Malta to	57°									
15 ,,	Port Said.	59°									
16 ,,		61°									
17 ,,	Suez Canal.	62°									
18 ,,		59°									
19 ,,		69°									
20 ,,		78°									
21 ,,	Suez to Aden.	71°									
22 ,,		77°								1	
23 ,,		74°									
24 ,,	Aden.	79°									
25 ,,		79°									
26 ,,		80°									
27 ,,		77°				1					
28 ,,		76°									
29 ,,	Aden to	77°									
30 ,,	Colombo.	78°								1	
31 ,,		80°									
1 Feb.		80°									
2 ,,		80°				2					
3 ,,		79°				2					
4 ,,	Colombo.	79°				2					
5 ,,		79°				2					
6 ,,		81°				1				1	
7 ,,		80°		1		3	1				
8 ,,		81°				6				1	
9 ,,	Colombo to	80°				3					
10 ,,	Singapore.	82°									
11 ,,		82°				2					
12 ,,		82°				3					
13 ,,		81°				1	1				
14 ,,	Singapore.	78°			1	1	1			1	
15 ,,		77°				1	1				
16 ,,		79°				1	2			1	
17 ,,	Singapore to	79°					2				
18 ,,	Hong Kong.	80°				1	1				
19 ,,		81°				3	2				
20 ,,		76°				1	1				
21 ,,		70°				3	3			1	
22 ,,		65°				1					
23 ,,		69°					1			2	
24 ,,		70°				1	1			1	
25 ,,		65°				2	4				
26 ,,	Hong Kong.	68°									
27 ,,		67°									
28 ,,		69°				2	4				
1 Mar.		67°				2	2			2	
2 ,,		65°				2	1			1	
3 ,,		65°				2	2			2	
				1	1	51	30			15	

Date, 1891.	Position of Ship.	Average daily temperature.	Mamestra brassicæ.	Tæniocampa stabilis.	Tæniocampa erudа.	Hadena chenopodii.	Hadena oleracea.	Eupitheeia centaureata.	Eupitheeia subnotata.	Eupitheeia absinthiata.	Pelurga comitata.
	Brought over..			1	1	51	30			15	
4 Mar.		66°				3	1			1	
5 ,,	Hong Kong.	67°				4	2			3	
6 ,,		66°				3	3			2	
7 ,,		66°				5	1			1	
8 ,,		73°				2				3	
9 ,,		80°					2	1		1	
10 ,,	Hong Kong to Singapore.	82°				2	2			5	
11 ,,		79°				2				4	
12 ,,		82°				2				1	
13 ,,		83°					3			3	
14 ,,	Singapore.	81°					2		1	3	
15 ,,		82°					1		1	4	
16 ,,		82°				1	2		2	3	
17 ,,	Singapore to	83°	2			1				3	
18 ,,	Trincomalee.	83°							1	5	
19 ,,		82°				1			5	7	
20 ,,		82°							5	3	
21 ,,		82°				1			5	2	
22 ,,	Trincomalee.	83°							6	3	
23 ,,		84°							3	3	
24 ,,		83°							7	2	
25 ,,	Colombo.	85°							6	1	
26 ,,		83°							5	3	
27 ,,		83°							8	2	
28 ,,		84°							9	1	
29 ,,		82°							7	3	
30 ,,	Colombo to	82°							5	2	
31 ,,	Aden.	79°							7	1	
1 April		81°							3		
2 ,,		82°							8		
3 ,,		82°				1			6		
4 ,,	Aden.	82°							3		
5 ,,		83°				1			3		
6 ,,		85°				1			5		
7 ,,		78°							3		
8 ,,	Aden to Suez.	75°							3		
9 ,,		73°							3		
10 ,,		74°							3		
11 ,,	Suez Canal.	95°							4	1	
12 ,,	Port Said.	78°									
13 ,,		64°							3		
14 ,,	Port Said	63°							1		
15 ,,	to Malta.	59°									
16 ,,		59°									
17 ,,		60°									
18 ,,	Malta.	60°									
19 ,,		66°									
20 ,,		60°									
21 ,,		60°							1		
22 ,,	Malta to	60°							1		
23 ,,	Gibraltar.	60°							1	2	
24 ,,		62°									
25 ,,	Gibraltar.	64°							1		
26 ,,		62°								1	
27 ,,		59°									
28 ,,	Gibraltar to	56°									
29 ,,	Plymouth.	54°									
30 ,,		50°									
1 May	Plymouth.	53°									
2 ,,	Portsmouth.	54°									
		Totals	2	1	1	81	49	1	135	94	

From the foregoing table it will be seen that (1), *Eupithecia absinthiata* was the first to make its appearance, the first specimen emerging on the 22nd January, our fourth day in the Red Sea, and twenty-first from England, the average temperature on that day being 77°. This species was peculiarly affected, the greater number of them emerging in the hottest weather, between the 10th and 30th March, after which they continued to appear at intervals up to the 26th April, by which time the ship had reached Gibraltar on her way home. But, strange to say, between the 7th and 13th May, while we were at Chatham, fourteen more appeared. The weather was then bright and warm.

(2). *Hadena chenopodii* appeared on the 27th January, and from that day until the 21st March they continued to emerge nearly every day, the greater number, however, appearing between the 2nd February and the 11th March, the increasing temperature seeming to affect them more rapidly than any of the other species, although one remained over, and did not hatch until the 7th May, at Chatham.

(3). *Tæniocampa stabilis.* Strange to say this species, which one would naturally expect to be the first to feel the effects of an increased temperature, did not put in an appearance until the 7th February, the day after the ship left Colombo, when the average temperature was 80°, and after the ship had been nearly three weeks in tropical weather.

(4). *Hadena oleracea* was not so quickly affected as *chenopodii*, the first emerging on the 7th February, and the second on the 13th, from which time they came out daily until the 16th March, after which date no more appeared.

(5). *Tæniocampa cruda* was still more remarkable than *stabilis*, as the only specimen bred did not appear until the 14th February.

(6). *Eupithecia centaureata.* A single example only appeared on 9th March.

(7). *Eupithecia subnotata* was not affected by the increase of temperature until the 13th March, the day before we arrived at Singapore on our way home, when the first specimen appeared. From this date they emerged almost daily until we reached Gibraltar on the 25th April, and one remained over and came out at Chatham on the 21st May.

(8). *Mamestra brassicæ.* I had not more than half-a-dozen pupæ of this species, and only two of them emerged, and the same day, the 17th March, on our homeward voyage between Singapore and Trincomalee. This is a moth I should have thought would have been earlier affected.

(9). *Pelurga comitata.* I obtained about four dozen larvæ of this species feeding upon *Chenopodium* at Chatham in September, 1890, but not a single moth appeared during the cruise, and I imagined that the pupæ had all perished. However, on the 11th August, at Sheerness, a fine female emerged. The larvæ were fed up in a large wide-mouthed bottle, and on the 6th September, as I required the bottle for other larvæ, I shook out the contents, and was surprised to find over two dozen healthy-looking pupæ, which evidently intend to lie over to next season. I may add that we left Sheerness on the 14th August for Bermuda and Halifax, where we had some hot weather, and returned to Portsmouth on the 25th instant.

The number of species experimented upon were not sufficient to enable any important conclusions to be drawn, although it would appear that a tolerably quick change from a very cold to a very warm climate induces early hatching; but that different species are differently affected, *Eupithecia* and *Hadena*, for instance, appearing before *Tæniocampa*, and *Pelurga** being in no way influenced.

It is an interesting subject, and I hope to be able to carry out experiments on a larger scale during the coming winter.

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* Since this paper was written the following note has been received from Mr. G. F. Mathew:—

H.M.S. 'Tyne,' Portland, Oct. 2nd, 1891.

My dear Sir,—Since I sent that little paper I have bred two *Pelurga comitata*, one on 30th September, the other on 1st inst., from the larvæ found thirteen months ago. They are very eccentric in their manner of appearance. Perhaps you would kindly add a footnote to my paper, and oblige yours, in great haste,

H. Goss, Esq. GERVASE F. MATHEW.